Influence of springtime phenology on the ratio of soil respiration to total ecosystem respiration in a mixed temperate forest

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Total ecosystem (Reco) and soil (Rs) respiration are important CO_2 fluxes in the carbon balance of forests. Typically Rs accounts for between 30-80% of Reco, although variation in this ratio has been shown to occur, particularly at seasonal time scales. The objective of this study was to relate changes in Rs/Reco ratio to changing springtime phenological conditions in forest ecosystems. We used one year (2003) of automated and twelve years (1995-2006) of manual chamber-based measurements of Rs. Reco was determined using tower-based eddy covariance measurements for an oak-dominated mixed temperate forest at Harvard Forest, Petersham, MA, USA. Phenological data were obtained from field observations and the JRC fAPAR remote sensing product. The automated and eddy covariance data showed that springtime phenological events do influence the ratio of soil to total ecosystem respiration. During canopy development, Reco rose strongly, mainly the aboveground component, due to the formation of an increasing amount of respiring leaf tissue. An increase in Rs was observed after most of the canopy development, which is probably the consequence of a shift in allocation of photosynthate products from above- to belowground. This hypothesized allocation shift was also confirmed by the results of the twelve year manual chamber-based measurements.